CLAIMS

What is claimed is:

1. A monitor that can detect a plurality of trace molecules, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a photoionizer that is coupled to said ionizing chamber;

an electrospray ionizer coupled to said ionizing chamber;

a switch that controls the operation of said photoionizer and said electrospray ionizer to control different modes of operation; and,

a detector that is coupled to said ionizing chamber.

2. The monitor of claim 1, wherein said electrospray ionizer includes a vaporizer.

3. The monitor of claim 1, further comprising a chemical ionizer coupled to said ionizing chamber and said switch.

4. The monitor of claim 3, wherein said chemical ionizer includes a vaporizer.

5. The monitor of claim 2, further comprising a vacuum interface coupled to said ionizing chamber and said detector, said vacuum interface having an entrance that is orthogonal to said electrospray ionizer vaporizer.

6. The monitor of claim 4, further comprising a vacuum interface coupled to said ionizing chamber and said detector, said vacuum interface having an entrance that is orthogonal to said electrospray ionizer vaporizer.

7. The monitor of claim 1, further comprising a processor that controls said switch.

8. The monitor of claim 1, wherein said switch operates in a mode where said electrospray ionizer and said photoionizer are sequentially activated.

9. The monitor of claim 1, wherein said switch operates in a mode where said electrospray ionizer and said photoionizer are simultaneously activated.

10. The monitor of claim 8, wherein said switch operates in a mode wherein said electrospray ionizer and said photoionizer each generates a positive ion, then each generates a negative ion.

11. The monitor of claim 8, wherein said switch operates in a mode wherein said electrospray ionizer and said photoionizer each generates pairs of positive and negative ions sequentially in time.

12. The monitor of claim 1, wherein said switch operates in a mode where said photoionizer is on and said electrospray ionizer is switched between on and off states.

13. The monitor of claim 1, wherein said switch operates in a mode wherein said electrospray ionizer is on

and said photoionizer is switched between on and off states.

14. The monitor of claim 1, wherein said electrospray ionizer and said photoionizer each have an electrode that is supplied a voltage from a same voltage source.

15. The monitor of claim 9, further comprising a chemical ionizer that is coupled to said switch and generates a positive ion sequentially with said electrospray ionizer and said photoionizer, and then generates a negative ion sequentially with said electrospray ionizer and said photoionizer.

16. The monitor of claim 10, further comprising a chemical ionizer that is coupled to said switch and generates a positive and negative ion pair sequentially with said electrospray ionizer and said photoionizer.

17. The monitor of claim 1, further comprising a valve that controls a flow of a sample through an inlet of said electrospray ionizer and an inlet of said photoionizer.

18. The monitor of claim 17, wherein said valve sequentially allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

19. The monitor of claim 17, wherein said valve simultaneously allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

20. The monitor of claim 17, wherein said valve creates different flow rates through said electrospray ionizer inlet and said photoionizer inlet.

21. A monitor that can detect a plurality of trace molecules, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a photoionizer that is coupled to said ionizing chamber;

an electrospray ionizer coupled to said ionizing chamber;

switch means for controlling the operation of said photoionizer and said electrospray ionizer to control different modes of operation; and,

a detector that is coupled to said ionizing chamber.

22. The monitor of claim 21, wherein said electrospray ionizer includes a vaporizer.

23. The monitor of claim 21, further comprising a chemical ionizer coupled to said ionizing chamber and said switch means.

24. The monitor of claim 23, wherein said chemical ionizer includes a vaporizer.

25. The monitor of claim 22, further comprising a vacuum interface coupled to said ionizing chamber and said detector, said vacuum interface having an entrance that is orthogonal to said electrospray ionizer vaporizer.

26. The monitor of claim 24, further comprising a vacuum interface coupled to said ionizing chamber and said

detector, said vacuum interface having an entrance that is orthogonal relative to said electrospray ionizer vaporizer.

27. The monitor of claim 21, further comprising a processor that controls said switch means.

28. The monitor of claim 21, wherein said switch means operates in a mode where said electrospray ionizer and said photoionizer are sequentially activated.

29. The monitor of claim 21, said switch means operates in a mode where said electrospray ionizer and said photoionizer are simultaneously activated.

30. The monitor of claim 28, wherein said switch means operates in a mode wherein said electrospray ionizer and said photoionizer each generates a positive ion, then each generates a negative ion.

31. The monitor of claim 28, wherein said switch means operates in a mode wherein said electrospray ionizer and said photoionizer each generates pairs of positive and negative ions sequentially in time.

32. The monitor of claim 21, wherein said switch means operates in a mode where said photoionizer is on and said electrospray ionizer is switched between on and off states.

33. The monitor of claim 21, wherein said switch means operates in a mode wherein electrospray ionizer is on and said photoionizer is switched between on and off states.

34. The monitor of claim 21, wherein said electrospray ionizer and said photoionizer each have an electrode that is supplied a voltage from a same voltage source.

35. The monitor of claim 30, further comprising a chemical ionizer that is coupled to said switch means to generate a positive ion sequentially with said electrospray ionizer and said photoionizer, and then generates a negative ion sequentially with said electrospray ionizer and said photoionizer.

36. The monitor of claim 30, further comprising a chemical ionizer that is coupled to said switch means to

generate a positive and negative pair of ions sequentially with said electrospray ionizer and said photoionizer.

37. The monitor of claim 21, further comprising a valve that controls a flow of a sample through an inlet of said electrospray ionizer and an inlet of said photoionizer.

38. The monitor of claim 37, wherein said valve sequentially allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

39. The monitor of claim 37, wherein said valve simultaneously allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

40. The monitor of claim 37, wherein said valve creates different flowrates through said electrospray ionizer inlet and said photoionizer inlet.

41. A method for detecting a plurality of trace molecules, comprising:

ionizing a trace molecule with a photoionizer at approximately atmospheric pressure;

ionizing a trace molecule with an electrospray ionizer at approximately atmospheric pressure;

detecting the ionized trace molecules; and,

switching a mode of operation of the photoionizer and the electrospray ionizer.

42. The method of claim 41, further comprising vaporizing a sample that contains the trace molecules.

43. The method of claim 41, further comprising ionizing a trace molecule with a chemical ionizer at approximately atmospheric pressure.

44. The method of claim 41, wherein the mode includes activating the electrospray ionizer and the photoionizer sequentially.

45. The method of claim 41, wherein the mode includes activating the electrospray ionizer and the photoionizer simultaneously.

46. The method of claim 44, wherein the mode includes activating the electrospray ionizer and the photoionizer so that each generates a positive ion, then each generates a negative ion.

47. The method of claim 44, wherein the mode includes activating the electrospray ionizer and the photoionizer so that each generates pairs of positive and negative ions sequentially in time.

48. The method of claim 41, wherein the mode includes maintaining the photoionizer on, while switching the electrospray ionizer between on and off states.

49. The method of claim 41, wherein the mode includes maintaining the electrospray ionizer on, while switching the photoionizer between on and off states.

50. The method of claim 44, further comprising ionizing a trace molecule with a chemical ionizer in a mode where the chemical ionizer generates a positive ion

sequentially with the electrospray ionizer and the photoionizer, and then generates a negative ion sequentially with the electrospray ionizer and the photoionizer.

51. The method of claim 44, further comprising ionizing a trace molecule with a chemical ionizer in a mode where the chemical ionizer generates a positive and negative ion pair sequentially with the electrospray ionizer and photoionizer.

52. The method of claim 41, wherein a sample with the trace molecules sequentially flows through an electrospray ionizer inlet and a photoionizer inlet.

53. The method of claim 41, wherein a sample with the trace molecules simultaneously flows through an electrospray ionizer inlet and a photoionizer inlet.

54. The method of claim 41, wherein a sample with the trace molecules flows through an electrospray ionizer inlet and a photoionizer inlet at different flow rates.

55. A monitor that can detect a trace molecule, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a vacuum interface that is coupled to said ionizing chamber through an entrance;

an electrospray ionizer that is coupled to said ionizing chamber and has a vaporizer that is orthogonal to said vacuum interface entrance; and,

a detector that is coupled to said vacuum interface.

56. The monitor of claim 55, further comprising a photoionizer coupled to said ionizing chamber.

57. The monitor of claim 55, further comprising a chemical ionizer that is coupled to said ionizing chamber and has a vaporizer that is orthogonal to said vacuum interface entrance.

58. The monitor of claim 55, further comprising a valve that controls a flow of a sample through an inlet of

said electrospray ionizer and an inlet of said photoionizer.

59. The monitor of claim 58, wherein said valve sequentially allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

60. The monitor of claim 58, wherein said valve simultaneously allows the sample to flow through said electrospray ionizer inlet and said photoionizer inlet.

61. The monitor of claim 58, wherein said valve creates different flow rates through said electrospray ionizer inlet and said photoionizer inlet.

62. A monitor that can detect a trace molecule, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a vacuum interface that is coupled to said ionizing chamber through an entrance;

a chemical ionizer that is coupled to said ionizing chamber and has a vaporizer that is orthogonal to said vacuum interface entrance; and,

a detector that is coupled to said vacuum chamber.

63. The monitor of claim 62, further comprising a photoionizer coupled to said ionizing chamber.

64. A monitor that can detect a plurality of trace molecules, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a photoionizer that is coupled to said ionizing chamber;

a chemical ionizer coupled to said ionizing chamber;

a switch that controls the operation of said photoionizer and said chemical ionizer to control different modes of operation; and,

a detector that is coupled to said ionizing chamber.

65. The monitor of claim 64, wherein said chemical ionizer includes a vaporizer.

66. The monitor of claim 65, further comprising a vacuum interface coupled to said ionizing chamber and said detector, said vacuum interface having an entrance that is orthogonal to said chemical ionizer vaporizer.

67. The monitor of claim 64, further comprising a processor that controls said switch.

68. The monitor of claim 64, wherein said switch operates in a mode where said chemical ionizer and said photoionizer are sequentially activated.

69. The monitor of claim 64, wherein said switch operates in a mode where said chemical ionizer and said photoionizer are simultaneously activated.

70. The monitor of claim 68, wherein said switch operates in a mode wherein said chemical ionizer and said photoionizer each generates a positive ion, then each generates a negative ion.

71. The monitor of claim 68, wherein said switch operates in a mode wherein said chemical ionizer and said

photoionizer each generates pairs of positive and negative ions sequentially in time.

72. The monitor of claim 64, wherein said switch operates in a mode where said photoionizer is on and said chemical ionizer is switched between on and off states.

73. The monitor of claim 64, wherein said switch operates in a mode wherein said chemical ionizer is on and said photoionizer is switched between on and off states.

74. A monitor that can detect a plurality of trace molecules, comprising:

a housing with an ionizing chamber that is approximately at one atmosphere;

a photoionizer that is coupled to said ionizing chamber;

a chemical ionizer coupled to said ionizing chamber;

switch means for controlling the operation of said photoionizer and said chemical ionizer to control different modes of operation; and,

a detector that is coupled to said ionizing chamber.

75. The monitor of claim 74, wherein said chemical ionizer includes a vaporizer.

76. The monitor of claim 74, further comprising a vacuum interface coupled to said ionizing chamber and said detector, said vacuum interface having an entrance that is orthogonal to said chemical ionizer vaporizer.

77. The monitor of claim 74, further comprising a processor that controls said switch means.

78. The monitor of claim 74, wherein said switch means operates in a mode where said chemical ionizer and said photoionizer are sequentially activated.

79. The monitor of claim 74, said switch means operates in a mode where said chemical ionizer and said photoionizer are simultaneously activated.

80. The monitor of claim 78, wherein said switch means operates in a mode wherein said chemical ionizer and said

photoionizer each generates a positive ion, then each generates a negative ion.

81. The monitor of claim 78, wherein said switch means operates in a mode wherein said chemical ionizer and said photoionizer each generates pairs of positive and negative ions sequentially in time.

82. The monitor of claim 74, wherein said switch means operates in a mode where said photoionizer is on and said chemical ionizer is switched between on and off states.

83. The monitor of claim 74, wherein said switch means operates in a mode wherein chemical ionizer is on and said photoionizer is switched between on and off states.

84. A method for detecting a plurality of trace molecules, comprising:

ionizing a trace molecule with a photoionizer at approximately atmospheric pressure;

ionizing a trace molecule with an chemical ionizer at approximately atmospheric pressure;

detecting the ionized trace molecules; and,

switching a mode of operation of the photoionizer and the chemical ionizer.

85. The method of claim 84, further comprising vaporizing a sample that contains the trace molecules.

86. The method of claim 84, wherein the mode includes activating the chemical ionizer and the photoionizer sequentially.

87. The method of claim 84, wherein the mode includes activating the chemical ionizer and the photoionizer simultaneously.

88. The method of claim 86, wherein the mode includes activating the chemical ionizer and the photoionizer so that each generate a positive ion, then each generate a negative ion.

89. The method of claim 86, wherein the mode includes activating the chemical ionizer and the photoionizer so

that each generate pairs of positive and negative ions sequentially in time.

90. The method of claim 84, wherein the mode includes maintaining the photoionizer on, while switching the chemical ionizer between on and off states.

91. The method of claim 84, wherein the mode includes maintaining the chemical ionizer on, while switching the photoionizer between on and off states.